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Countdown

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RLV TOW TEST

VIKAS ENGINE QUALIFICATION HOT TEST

Page 08

MECHANISMS ASSEMBLY FACILITY INAUGURATED

Page 16

REPUBLIC DAY CELEBRATIONS 2021

Page 29

MESSAGE

Let us all welcome the New Year 2021 with renewed hopes and aspirations; with the knowledge and experience gained from the previous year, better equipped to handle disruptions of this magnitude.

Looking back, 2020 began with no indication of the surprises in store. Though there were sporadic cases of COVID-19 reported in our country, no one fathomed the magnitude and severity with which the pandemic was going to affect us. But all that is history now and mankind is demonstrating its tremendous resilience to come back to normalcy.

Global Space science and technology endeavours including that of ours were not entirely stagnant in the testing times of COVID-19. Major programmes were undertaken and missions accomplished by all the Space faring nations and agencies including private entrepreneurs. SpaceX made the first commercial crew transportation to ISS through its Dragon module, NASA Mars rover, Perseverance, commenced its journey to the red planet. In fact, Mars was a favourite destination to many in 2020 including the UAE; they did the Hope mission atop Japanese launch vehicle. China did the Chang'e 5 mission. ESA and NASA joined to launch the solar orbiter mission. The record of the overall launches, satellites put in orbits and business as a whole were excellent giving us great hope for the future.

India was not left far behind during this testing times by the dedicated team ISRO. Amidst the restrictions, containments and protocols imposed on us by the pandemic, we skillfully managed to place eleven satellites including nine commercial satellites in precise orbits using our PSLV-C49 and C50 missions. Establishment of Virtual Launch Control Centre (VLCC) in its full complement with two-way communication was a major accomplishment. Along with VLCC, enforcement of standard operating protocols and ensuring minimum participation of personnel in launch campaign made it safe and secure. Activities towards the future programmes such as RLV-LEX and ORV, SSLV, TVP, HRLV and Gaganyaan systems have shown considerable progress with a number of technology demonstration tests as well as systems qualification.

All of us in VSSC are very proud that we could convert the restraining conditions of COVID-19 pandemic to opportunities. The entire VSSC community rose to the occasion and devised many means for societal support to counter the threats. During early days of pandemic, masks, sanitizers and novel hands-free dispensing methods were developed by our team and distributed for public use in large numbers. Three models of ventilators of different levels of complexity were developed. We could make progress on Technology Developments and Research activities as work from home assignments. Even when scientists and engineers were confined to their homes, substantial progress was reported in R&D proposals. Pan entities and projects around 800 TDP proposals could be reviewed; of which approximately 330 were new proposals generated during this period. All these were accomplished during the extended lockdown periods. We need to keep the momentum with the development activities even while we are back to offices.

We have ambitious plans for 2021. VSSC has the mandate to develop most of the Gaganyaan systems such as Human rated GSLV MkIII, Integrated Vehicle Health Management Systems, Crew Escape Systems, Crew module elements and Test Vehicle for validation of Crew Escape System. We will be undertaking challenging developments like RLV LEX: the autonomous runway landing experiment, RLV-ORV: the orbital vehicle riding on a truncated GSLV, SSLV: the much-anticipated game changer in small launch vehicle scene, The Test Vehicle: the test bed for future technologies and PS4 autonomous orbital platform: the orbital test bed with commanding capability. We will also be developing many new technologies in propulsion systems, materials and composites, miniature avionics, new chemicals and energetics, analysis tools, software, simulation test beds, etc. The facility and infrastructure development in critical technology areas such as wind tunnels, thermal testing facilities, electronic production and screening facilities, material processing, chemicals and energy storage devices production as well as new GOCO operated facilities for production of sub-systems are to be pursued with vigour. The administration and auxiliary services have rendered commendable services during the difficult times of severe resource crunch to keep our Centre functioning and meeting our mandates.

In 2020, Government announced major initiatives in Space sector by inviting private entrepreneurs to be co-travellers in developing Space technology and systems along with ISRO, and ISRO was directed to be a facilitator and mentor. INSPACe was announced as the new organisation to facilitate this process. This has opened up a lot of opportunities with more possible investments in this sector. This new policy will help in creating a vibrant Space enterprise in this country which will bring more opportunities, explore new markets, enhance business in Space-based services, and allow ISRO to concentrate more on the technology developments.

In the new year, we have to align with the new norms of living and working. Our work environment has to be more automated and connected. Ability to monitor and support work from home is to be enabled, more computing power and connectivity is to be established, working with industry to be made through virtual mode and travel to be minimised, recruitment and review has to be in online mode. Towards this, good work done by our computer and network team in developing new software and infrastructure is to be appreciated.

I wish and pray that you, your family and colleagues experience great joy, warmth, togetherness and prosperity in 2021. Let us ensure committed work in VSSC to achieve all the goals that we have set for ourselves for the year ahead.

Wish you all the very best. Jai Hind.

S Somanath
Director, VSSC

Ceramic matrix composite fasteners for high temperature applications

Introduction

A fastener is a hardware component that is used to mechanically join (fasten or affix) two or more objects together. In general, fasteners are used to create non-permanent joints, that can be removed or dismantled without damaging the components being joined. Permanent joints such as welded, brazed, adhesion bonded and riveted joints, tend to get damaged or destruct both the joining components when removal is attempted. As structural components in aerospace applications are often subjected to extreme environments like high pressure and temperature in a flight beyond Earth's atmosphere, high heat flux and oxidizing environment during re-entry to Earth's atmosphere or exposure to burning rocket fuel in ascent flight – they must be designed and constructed to withstand these conditions, even to the level of fasteners which hold them together. As a result, several different designs of high-quality fasteners have been developed such as screws, nuts, bolts, pins, and collars, which are suitable for the specifications and standards of aerospace industry. The main characteristics and qualities of aerospace fasteners are :

- High corrosion and oxidation resistance
- High tensile, shear, and fatigue strength
- Lightweight
- Operational capabilities in extreme environments (low and high temperatures and pressures)
- Self-sealing and self-locking capabilities (to prevent fluid leaks and loosening during operation)

For majority of the structural aerospace applications, fasteners made out of common metals and alloys such as aluminum and stainless steel are adequate for temperatures up to 300°C. But for applications that involve extreme temperatures, special types of fasteners made out of following materials are used:

a) Nickel-based super alloys (usable up to 900 °C)
b) Refractory metals such as molybdenum, niobium, rhenium, tantalum and tungsten (usable up to 1100 °C)
c) Ceramic matrix composites such as C/SiC (usable up to 1650 ^{0}C)

Ceramic matrix composites

Chemically, ceramics are compounds consisting of a metallic atom with one or more non-metallic atoms bonded by covalent or ionic bond e.g. SiO_2, Al_2O_3, SiC, SiN_3. The high melting point of ceramics (SiO_2: 1600°C, Al_2O_3: 2072°C, SiC: 2730°C, SiN_3: 1900°C) as compared to generally used metals and alloys (steel:1540°C, iron:1150°C, titanium:1670°C, aluminium:660°C) is the reason for their consideration as high temperature structural materials. However, the monolithic ceramics (SiC, Al_2O_3, SiO_2) exhibit poor fracture toughness, thereby limiting their use as structural fasteners for high temperature applications.

A composite material has two or more distinct but compatible phases (continuous phase called matrix and reinforcement phase in the form of fibres/whiskers/particulates) which exhibit synergy and thus result in high toughness, which is better than monoliths. Engineered composite material such as Carbon/Carbon (C/C) composite comprising of carbon fibre reinforced in carbon matrix is well known for its high strength at temperatures ~2600°C, but needs to be protected from oxidizing environment above 450°C with suitable oxidation resistance coating (generally SiC coating). The viable solution to this limitation posed by C/C composites is fibre reinforced ceramic matrix composites (referred as CMCs), which consist of carbon or silicon carbide fibres as reinforcement and ceramic as matrix. SiC ceramic, a non-oxide ceramic, exhibits high creep resistance (capability of material to resist deformation under load over prolonged period) and thus retains high strength up to 1650°C. In an oxidizing atmosphere at these temperatures, SiC oxidizes to passive oxide (SiO_2) which prevents further oxidation of the remaining SiC. This property of SiC makes it superior to carbon and eventually carbon fibre reinforced silicon carbide based CMCs (C/SiC) composite superior to C/C composite. C/SiC composites possess high specific stiffness, high specific strength and high

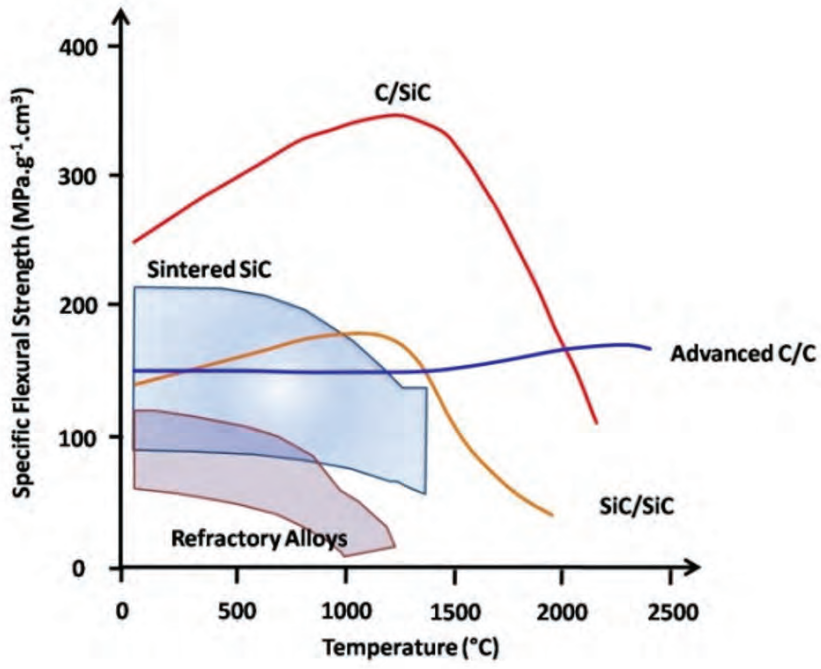


Figure 1: Schematic of variation of specific flexural strength of C/SiC with respect to other high temperature materials

damage tolerance. A schematic of the variation of specific flexural strength of C/SiC with respect to other high temperature materials is given in figure 1.

CMC fasteners

With ISRO embarking on challenging projects for futuristic re-entry missions such as Reusable Launch Vehicles (RLVs) and Scramjet Powered Hypersonic Vehicles, there is significant demand for development of suitable Thermal Protection System (TPS) components for re-entry such as leading edges of wing, nose cap, combustion chamber components for scramjet propulsion, nozzle exit cones, etc. These components made out of C/SiC materials tend to be superior due to their inherent thermo-oxidative stability coupled with high specific strength. C/SiC fasteners are required to join such C/SiC based thermo-structural components while matching the coefficient of thermal expansion of C/SiC structures. They ensure detachable non-permanent joints to facilitate inspection/overhauling of the ceramic TPS after every re-entry mission. The present article gives a brief overview on development of CMC based fasteners which find suitable applications for joining of CMC based thermal protection systems.

Design of C/SiC fasteners

The design of CMC fasteners, in general, calls for the selection of reinforcement capable of withstanding high-temperature and a ceramic matrix, separated by a relatively weak interphase - that facilitates load transfer between the matrix and fibre reinforcement as well as acts as a mechanical fuse, aiding in deflection of cracks from brittle matrix parallel to the fibre axis. This ensures failure of CMC fastener in a benign manner than an otherwise catastrophic brittle failure. Carbon fibre, woven as fabric or in multiple dimensions, is the most preferred reinforcement, while silicon carbide is mostly preferred material for matrix. Pyrolytic Carbon (PyC) is the preferred material for interphase. For C/SiC fasteners, reinforcement needs to be oriented in such a way that fibre is present along the longitudinal direction for tensile strength as well as in radial direction for thread shear strength. Attempts made worldwide for realizing composite fasteners are categorised below:

a) Commercially available C/C fasteners realized by needle punched carbon felt followed by pitch impregnation process.
b) C/C fasteners realized by spun yarn graphitized carbon fabric followed by resin infiltration process.
c) C/C and C/C-SiC fasteners realized by fibre-shank braiding methodology followed by matrix infiltration using hybrid Polymer Infiltration & Pyrolysis (PIP) and Chemical Vapour Infiltration (CVI) process.
d) C/C-SiC fasteners realized by stacked 2D (two-directional) fabric prepreg lay-up followed by carbonization of matrix and Liquid Silicon Infiltration (LSI) process.
e) C/SiC fasteners realized by stitched 2D laminate followed by matrix densification using CVI as well as PIP process.
f) C/SiC fasteners realized by 3D (three-directional) needled and 4D (four-directional) fibre preforms followed by matrix densification using PIP process.

In house development at VSSC

Ceramic Matrix Products Division of PCM Entity, VSSC has undertaken the development of fiber reinforced CMCs in a focused way from R&D level to the stage of component realization. With the establishment

Figure 2: C/SiC based M8 fasteners realized

of CVI facility in 2014, C/SiC composites with improved thermo-mechanical properties are realized. Advanced R&D project on CMC fasteners for high temperature applications was pursued and C/SiC based M8 fasteners (figure 2) have been indigenously realized by the CVI process.

The overall fabrication process comprises of stacking carbon fabric plies followed by stitching in stack direction using needle. PyC interphase coating over carbon fabric stitched laminate is provided followed by SiC matrix infiltration using CVI process. The C/SiC fasteners have been realized using CVI based matrix densification of carbon fabric stitched plies, which is progressively machined to blocks followed by machining to fasteners as described in figure 3.

Salient features of indigenous C/SiC fasteners :

- ✓ Low density (2.10 g/cm^3) ensures weight saving for aerospace applications
- ✓ Matching coefficient of thermal expansion with CMC based TPS/combustion chamber ensures no stress concentration at joints
- ✓ Retention of strength at high temperature (tensile strength of C/SiC M8 bolt at room temperature: 190 MPa and at 1100°C in atmospheric condition: 170 MPa)
- ✓ Structural continuity at fastened joints of CMC TPS/combustion chamber ensured
- ✓ No possibility for arcing at fastened joints in case of lightning strike on airframe of re-entry vehicle and no galvanic corrosion at fastened joints

C/SiC fastener vs metallic fastener for high temperature applications

Commercially available high temperature fasteners are generally fabricated using alloys of titanium, zirconium and molybdenum (TZM). However, high density of TZM alloy (~ 10 g/cm^3) renders it unfit for usage as fasteners for joining CMC components as it induces additional weight at joints leading to stress concentration at these points. Moreover, TZM alloy fasteners undergo oxidation at temperature above 800 ˚C in presence of air as shown in figure 4.

Figure 4: Oxidized TZM alloy bolts after heating beyond 800°C in air

Although TZM alloy fasteners have higher load bearing capacity than C/SiC fasteners at room temperature as shown in figure 5a, the C/SiC fasteners offer the advantage of retention of strength in oxidizing conditions at high temperatures up to 1500°C at which the strength of TZM alloy is reduced to 25% of its strength at room temperature and becomes comparable to C/SiC material, as shown in figure 5b.

Thus, C/SiC fasteners are promising alternative to commercial refractory metal fasteners for applications in oxidising atmosphere at high temperatures.

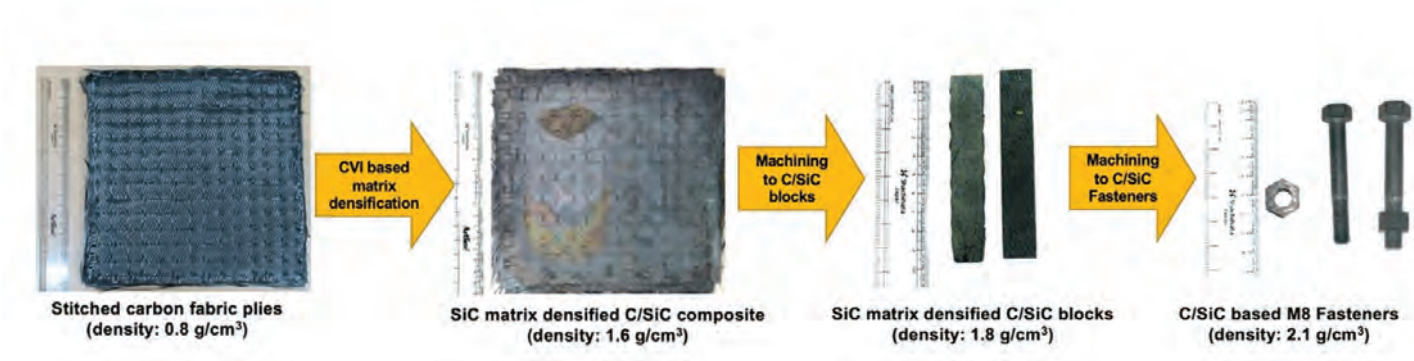


Figure 3: Process flow chart for realization of C/SiC fasteners

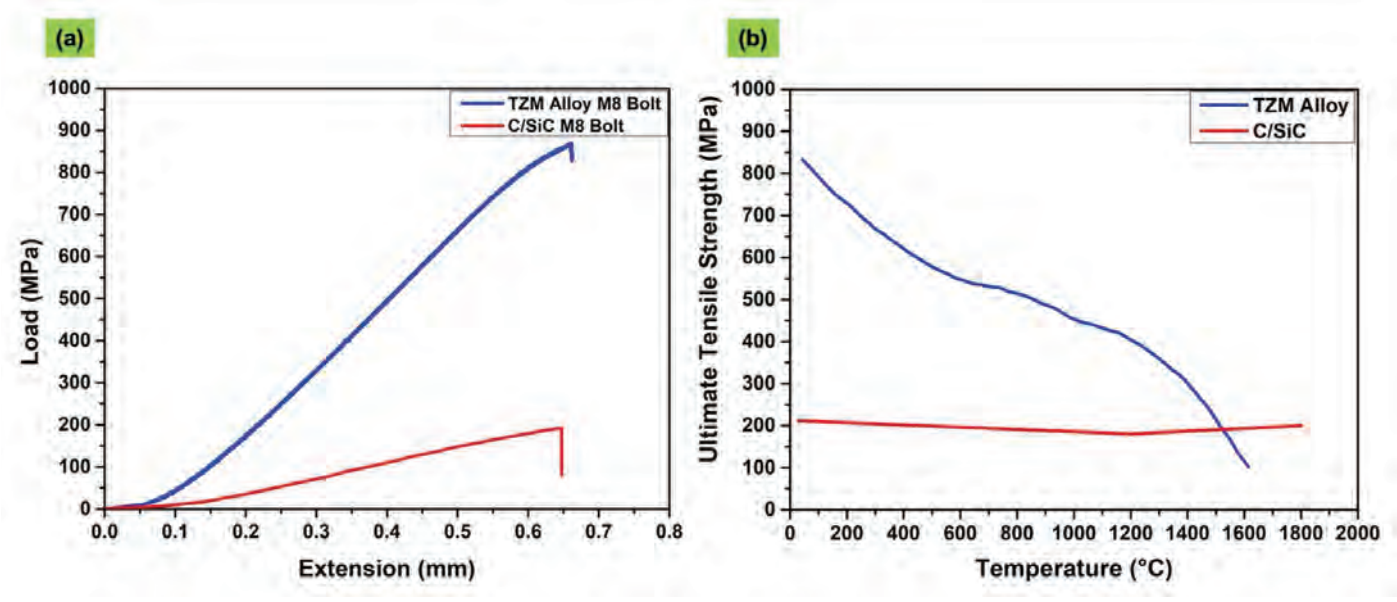


Figure 5: Comparison of C/SiC fasteners against TZM alloy fasteners

Future prospects

World-over carbon fiber reinforced CMC fasteners are the candidates of choice for joining of hot structures to airframe for re-entry vehicles as well as for joining CMC based nozzle extensions for cryogenic stages. VSSC has taken a lead role in realizing C/SiC fasteners by CVI process and has proven the technology in realizing C/SiC based M8 fasteners, at par with international standards. The capability to supply CMC fasteners is being established to cater to future flights of RLV and Scramjet Powered Hypersonic Vehicles as well as for CMC based divergent nozzle extensions for cryogenic engines.

Courtesy : Shobhit Kumar, Anil Painuly
CMPD/ASCG/PCM

RLV Tow test

The phase-1 Tow test of RLV Landing EXperiment (RLV-LEX) was demonstrated successfully near Brahmprakash Complex, TERLS as a forerunner to the Tow test at ATR, Chitradurga, Karnataka. The test configuration consists of a prime mover, separation system and RLV. The prime mover was customized for tow test requirements. The separation system is based on an explosive nut mechanism. During tow test, the RLV with nose landing gear in lifted condition is towed by a prime mover. Once the required velocity is attained based on the test cases (2 m/s, 5 m/s and 10 m/s), a pyro system is activated for separating the RLV from the prime mover. Subsequently, the on-board software in RLV will steer the vehicle to align to the centre of runway and brakes will be applied to bring the vehicle to halt.

From the Tow test

Tow test at TERLS was carried out in order to simulate the RLV manoeuvres during ground roll phase at velocities <10m/s, to evaluate performance of the landing gear systems viz. nose wheel steering, braking actuator and updation of the mathematical models for RLV-LEX. Start and release points of RLV and azimuth of center line of the runway area near Brahmprakash Complex, TERLS were surveyed for initialization of navigation system.

Initially, navigation trials were carried out to verify the performance of miniAINS and the accuracy of miniAINS was found to be at sub meter level for the trial duration. Clean separation of RLV was demonstrated up to the release velocity of 10 m/s. Guidance and Control algorithms based on inputs from navigation system commanded the nose wheel steering. Brake actuators of the main landing gears ensured the vehicle stop within the runway limits. Mobile checkout system was realized and demonstrated successfully for tow test which was used for powering, commanding the vehicle and monitoring of critical parameters for the checkout operations till the start of the test.

Real time display system which receives the data from RF telemetry through S-band receiver and displays the critical parameters in real time was demonstrated successfully. Performance of new avionics packages like Landing Gear Control Electronics (LGCE), Solid State Data Recorder (SSDR), Standard Definition Video Data Recorder (SDVDR) and Structural Data Measurement Unit (SDMU) were also demonstrated successfully. A mobile cool air unit, was installed and its performance to ensure the thermal management of avionics systems was demonstrated successfully.

Vikas engine qualification hot test (HS-1) for Gaganyaan

As part of the L110 Vikas engine qualification testing for Gaganyaan program, three long duration qualification tests and four short duration off-nominal tests are planned. HS-1 was the first L110 Vikas qualification hot test for Gaganyaan mission corresponding to 1.2 times the nominal L110 flight burn duration. Accordingly, the test was successfully carried out with a chamber pressure of 58.5 bar for a duration of 240 s at Principal Test Stand (PTS), IPRC on December 30, 2020.

HS-1 Engine test progressing at Principal Test Stand (PTS), IPRC

Key features

Key features of HS-1 Vikas engine hardware includes quadruple redundant Command System Module (CSM), assembly meeting human rating standards, silica phenolic Liquid Engine Throat (LET) meeting specification corresponding to 62 bar operating condition, improved throat system interface configuration with application of ceramic putty at throat - Throat Retainer Ring (TRR) interface and improved TRR welding procedure.

LET throat insert for L110-G

The bias-wound silica phenolic liquid engine throat, designated as LET is developed by CMSE. It is a unified throat for all the versions of Vikas engines, viz. L40, PS2, GS2 and L110 for HP (58.5 bar) and HT (62 bar) application. The processing of throat block, comprising of winding and curing, has been unified into a common process, and the throat for each of the above mentioned versions of Vikas engine can be machined to the specific configuration from the common block. The dual ply orientation of 60°/30° is chosen to cater for longer operating duration and to have improved margins for the Vikas engines.

Ceramic putty at TRR-throat interface

Ceramic putty (VTB 304L) is developed by PCM for Vikas engine application. This is a two part system, in which first part is a mixture of silica powder and

graphite powder and second part is a solution of potassium silicate in water. This can resist up to ~1000 °C of temperature and it is also room temperature curable. A series of subscale level and thrust chamber level trials and tests were conducted with improved TRR welding process and ceramic putty application at interface.

NDT inspections

As part of Gaganyaan requirement, more stringent screening and quality protocols were followed for the engine system. Additional non-destructive testing viz. pre-test and post-test tangential radiography were introduced. This was carried out for the HS-1 Vikas engine chamber.

Engine performance

HS-1 Vikas engine performance was normal in the test. Chamber pressure and throat back wall temperatures indicating performance of the throat system and the engine were as predicted.

Igniter for low altitude escape motor of CES-Gaganyaan developed

A pyrogen igniter has been designed and developed by ASOE for ignition of the Low altitude Escape Motor (LEM) - the largest motor among the Crew Escape System (CES) motors. Unlike the pyrogen igniters used in launch vehicle stages which employ composite cases, this igniter utilises a high strength metallic case (15CDV6 steel) considering the high operating pressures in the range of 15 MPa, which is insulated externally with Rocasin for withstanding the motor environment. The technological heritage of this igniter is derived from the Pad Abort Test (PAT-01) version. However, certain design improvements have been incorporated viz. (a) multiple canted nozzles (6 nos.) in place of a single axial nozzle, considering the specific requirement of minimal motor igniter delay after abort command and (b) Head Mounted Safe Arm (HMSA) based initiation system to meet the enhanced safety and reliability requirements for human-rating. Initiation is accomplished by two numbers of initiators, each equipped with dual bridge-wire redundancy and 1A/1W no fire rating. Boron-potassium nitrate pellets serve as booster charge. Propellant consists of a high burn-rate AP-HTPB-Al composition (PEDPRO 2421), presently used in all solid motor igniters in a multi-starred grain configuration. To rule out suspected issues related to unstable burning in 14-27 MPa range and resultant change in Saint Robert - Vielle's law (burn rate law) for AP based propellant as cited in literature, this particular composition was separately evaluated through an instrumented test campaign. No discernable change in burn rate was observed.

After conceiving the design and realising the hardware components and propellant grain,

two functional tests of the igniter were conducted. Performance in the tests closely matched predicted ballistic parameters, and excellent reproducibility was obtained for the two tests.

Ballistic parameters

Parameter	Test-01	Test-02
Maximun Pressure (Pmax), MPa	14.53	14.54
Average Pressure, MPa	13.95	13.91
Burn time, ms	617	610
Ignition delay, ms	21.8	20.2

Structural testing and qualification of GSLV MkIII Ogive Payload Fairing

Payload fairings (PLF) are designed to protect spacecrafts during the ascent phase of launch vehicle against aerodynamic, thermal and acoustics loads. In our launch vehicles conical nose cone was the preferred configuration for payload fairings. After the first experimental flight – the LVM3-X/CARE mission, from GSLV MkIII-D1 flight onwards, the payload fairing configuration of GSLV MkIII was changed from conical to ogive nose cone due to the advantage of reduced aero dynamic drag and aeroacoustics. In this present configuration, the GSLV MkIII Ogive Payload Fairing (OPLF) is having height 10.7 m, diameter 5 m and mass around 2100 kg.

During the ascent phase mission, payload fairings are subjected to aero dynamic loads, acting as pressure on the surface and as inertial loads due to acceleration of the vehicle. As part of design validation, launch vehicle structures are required to be subjected to qualification tests with appropriate boundary conditions applying ultimate flight loads. An augmented structural qualification test of OPLF was carried out at FAST / INSTEF recently.

Previous scheme followed for structural qualification tests of payload fairing was limited to the application of pressure load on nose cap and nose cone and shear forces at joints of nose cap/cylinder and nose cone/cylinder. This scheme demanded only cap and cone pressure chambers and shear loading lines. This scheme was found to be inadequate for complete qualification for various load conditions of flight.

Test configuration for external pressure

The following test conditions were recommended.

1. Nose cap and ogive nose cone qualification under external pressure

2. Cylinder qualification under external pressure and application of shear forces for buckling

3. Rivet qualification (linear bellow system-piston/cylinder) under internal pressure in boat tail and cylinder and shear forces

4. Joints qualification with station loads

In these, cylinder buckling margin demonstration under external pressure and piston cylinder rivet qualification under internal pressure were planned for the first time. The new test scheme necessitated design and realisation of new type of external pressure chambers for Ogive cone, cylinder and internal pressure chamber for boat tail along with, pressurisation bladders. Fabrication / transportation and storage of single shell pressure chambers with external diameter 5.7 meter were very difficult and hence dismantle type ogive

pressure chambers were designed and realized. For the first time, structural **I** - beams were bent in ogive profile for the fabrication.

The OPLF used for the test is realized by altering the LVM3-X mission conical PLF hardware and attaching the ogive nose cone. Assembly of the test setup with pressure chambers and pressurisation bladders was a challenge due to height restrictions, handling requirements and very small radial gaps between OPLF and pressure chambers. The sequence of the assembly was thoroughly mapped and meticulously undertaken. The test article was instrumented with strain gauges, displacement transducers, digital image correlation techniques and acoustic emission techniques.

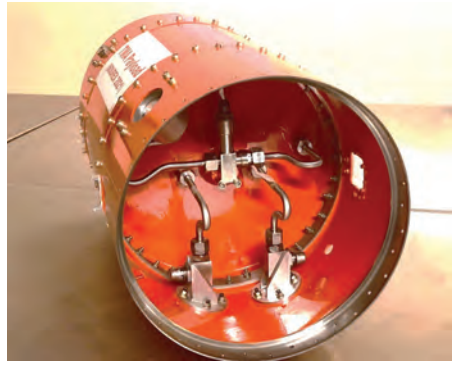
The qualification of cap, ogive and cylinder was successfully completed under external pressure and shear force. The structure was qualified under compression and tension cases for station load simulation in Pitch and Yaw planes. Margin against cylinder buckling under external pressure and loads was demonstrated for Ø5 m OPLF.

TMA payload for SOUREX/RH560 MkIII experiment passes critical flow test

Director, VSSC inspecting the test setup

The second SOUREX experiment, planned during March 2021 by SPL from SDSC SHAR using RH560 MkIII rocket, consists of a Trimethyl Aluminium (TMA) chemical payload along with Electron density and Neutron Wind (ENWi) and Langmuir probes. The TMA experiment is designed to gain a better understanding of the high-altitude (90-180 km) winds and help improve the models on electromagnetic regions of Space which are critical for spacecrafts and communication systems.

TMA, a pyrophoric liquid, serves as a chemical tracer and creates a visible trail in twilight atmosphere that lasts for a few minutes which can be photographed from multiple sites. TMA dispenser consists of a hydro pneumatic piston-cylinder mechanism working in blow-down mode. It consists of a 15CDV6 steel canister which separates inert gas (argon) charged at 1.2 MPa and the TMA-TEA liquid mixture using a floating piston. The aluminium piston is provided with special Quad-ring seal with Brass Filled Teflon (BFT) backup and Viton energizer O-rings to ensure very low friction and leakage. The system also carries plumb lines for chemical filling/draining and a discharge line with a Normally Closed Pyrovalve of 6 mm port size.



TMA payload

The current TMA experiment is an extension of the successful SOUREX-2018 performed at an altitude of 90-110 km on-board RH300 MkII from TERLS. However, in comparison with phase-I TMA payload, the present version incorporates certain changes. Chemical loading has been increased to 6.5 kg from 2 kg. This translates to a higher average mass flow rate of 260 g/s for a duration of 23 s taking in account the higher RH560 MkIII rocket velocity. The liquid is dispensed through a 3.9 mm orifice in place of 1.8 mm in the earlier case. In addition, unlike the RH300 payload, the modular design forms part of the rocket structure, which simplifies the flight integration to a great extent.

Processing and chemical filling of the payload is planned in the new PEARL facility of ASOE using a recently commissioned 8-port inert gas glove box work station. Filling trials have been completed using a simulant fluid (Isrosene) and all the flow parameters validated through an expulsion experiment carried out at ASOE test facility, wherein all the test results were achieved within predicted bounds.

Indigenisation of chip resistors

Chip resistors contribute to nearly 36% of the total Electrical and Electronics Engineering (EEE) components used in launch vehicle programmes. As part of Make-in-India program, towards self reliance in the regime of electronic parts, AVN has taken up the development, realization and testing to European Space Agency and Military standards, of thin film Surface Mount Technology (SMT) chip resistors through indigenous source. The resistors (Range: 47Ω to 1MΩ, TCR: ±25ppm/°C, Tolerance: ±1%, Power: 0.25W, Voltage: 100V) have been realized as Form, Fit and Function equivalent to imported Vishay make SMT resistors. The devices have been qualified to European Space Components Coordination (ESCC) General Specification No. 4001 and MIL-PRF-55342H.

Handing over of indigenised chip resistors

Shri S Somanath, Director, VSSC received the indigenised chip resistors from Shri Sapinder Singh, Managing Director, M/s Omega Products Pvt. Ltd., Mumbai in a function held at VSSC on January 21, 2021. The Qualification Certificate and the Process Identification Document were handed over to MD, Omega Products by Shri S Saratchandran, Deputy Director, VSSC (SR) and Smt S Athula Devi, Deputy Director, VSSC (MSA).

RF systems for IIST ground station

AVN has designed and developed six ground station systems based on the requirement from IIST for the Small Satellite systems and Payload Centre (SSPACE), being established at Valiamala, for communication with satellite payloads. IIST is involved in the design of INSPIRESAT-1 in the

Handing over of RF systems

nanosatellite category proposed for launch in PSLV-C52 and PS4 orbital platform experimental payloads.

The systems realized include S-band down converter, three S-band Low Noise Amplifiers (LNAs), S-band pre-driver amplifier and VHF and UHF driver amplifiers. These are required at the ground station to support command uplinking and telemetry data reception from the onboard systems.

The feed-mountable small-aperture hermitically sealed LNAs with in-built bias-tee and rack-mountable down converter in 1U configuration are part of the downlink processing chain for acquiring data and telemetry signal from payloads. The pre-driver and driver amplifiers at different frequency bands boost the low RF power to a level required by the final 300 W/500 W power amplifier for transmitting commands to payloads. Milled chassis with fins for housing the driver amplifier helps adequate thermal margin without forced air cooling.

Indigenously developed systems were handed over by Shri S Somanath, Director, VSSC to Dr VK Dadhwal, Director, IIST on January 25, 2021 in presence of Shri Roy M Cherian, Associate Director, VSSC, Dr Sharad Chandra Sharma, Associate Director, VSSC (R&D), Shri YVN Krishnamurthy, Registrar IIST and Dr G Ayyappan, Chairman, ASRG, IIST. A brochure on the RF products was released by Director, VSSC in this connection. User Manual was handed over by Shri M Narayanan Namboodiripad, Deputy Director, VSSC(AVN) to Dr H Priyadarshnam, Principal Investigator, IIST Satellite Projects and Test Reports were handed over by Shri KK Mukundan, Group Director, RFSG to Dr P Raveendranath, Principal Investigator, IIST Satellite Ground Station.

Silica Aerogel, Film Adhesive, Rocasin and EPDM based insulation material to industries

Handing over of technology transfer documents

VSSC has developed the technologies of Silica Aerogel, Film Adhesive and EPDM based Insulation Material for launch vehicle applications which finds other societal/commercial applications.

Silica aerogel powder

Silica aerogel exhibits porosity greater than 90% and has low

density, low thermal conductivity, low dielectric constant and high acoustic impedance. This aerogel has scope for wide variety of applications like window glazing, acoustic insulation, cryo-tank insulation, kinetic energy dampener, thermal insulation, dielectric substrates, catalyst support, foot-soles, etc.

Silica aerogel based composite sheet

Silica aerogel based composite sheets are flexible and hydrophobic. Sheets made from the aerogel powder have a gamut of applications. Lab scale technology developed has been demonstrated in thermal protection system since PSLV-C39. Aerogel sheets are ideal to be used as wrap around insulation, which can be cut to desired size and integrated. Aerogel sheets developed in VSSC are non-dusting and are easy to handle.

Film adhesive, EFA-1753 and 1752

EFA-1753 (300 GSM) and EFA-1752 (200 GSM) in the form of continuous film cures at elevated temperature of 175 °C for 1 hr and possess good filleting property. These are extensively used for the fabrication of light-weight honeycomb sandwich structures.

EPDM based thermal insulation material

A light weight/low density solid rocket motor thermal insulation material based on Ethylene Propylene Diene Monomer (EPDM) rubber compound shall be processed in the form of sheets of required thicknesses by calendering or extrusion. The advantage over the conventional Nitrile butadiene rubber (NBR) system is its 15% lower density values, resulting in lesser inert mass. Also the thermal insulation capability is 10-15% better than other similar insulations. The material also exhibits excellent rubber to metal and rubber to carbon-carbon composite interface adhesion, enabling it for use as multilayer structural element and leak free joint.

ROCASIN

ROCASIN is a rubber based solid motor case insulation. This material is used in solid motors of ISRO launch vehicles. It has high strength and excellent thermal erosion resistance properties.

In accordance with the established policy of ISRO of encouraging Indian Industries for productionising matured technologies, the technologies were transferred to the following industries through NSIL:

1. Silica aerogel powder, silica aerogel based composite sheet and EFA-1753 and 1752 to M/s Anabond Ltd., Chennai
2. Silica aerogel powder, silica aerogel based composite sheet to M/s Bhukhanwala Industries, Mumbai
3. EPDM based thermal insulation material to M/s Aerospace Materials Pvt Ltd., Coimbatore
4. EPDM based thermal insulation material and ROCASIN to M/s Economic Explosives Ltd (EEL), Nagpur

The TT agreements were signed by M/s NSIL. The technology transfer documents were virtually handed over to the above four industries by Dr SA Ilangovan, Deputy Director, VSSC (PCM), Shri M Mohan, Deputy Director, VSSC (MME) and Shri J Jayaprakash, Deputy Director, VSSC (SPRE) in presence of Shri S Somanath, Director, VSSC on January 12, 2021.

Scramjet test combustor components handed over

Currently, Air Breathing Propulsion Project is working on development of supersonic combustion technology with Isrosene as fuel as one of the critical technologies identified for Scramjet Powered Hypersonic Vehicle. Demonstration of supersonic combustion of Isrosene vapour-air mixture inside a test combustor and sustaining the flame is highly complex in nature and challenging. Towards this, a scramjet combustor is realized and it is to be tested on ground in connected pipe mode in Scramjet Propulsion Test Facility established at IPRC, Mahendragiri. Test conditions are Mach No: 2.4, Total temperature: 1800 K, Total pressure: 1.5 MPa and duration: 11-13 s.

The realized rectangular cross section combustor (15CDV6) is of heat sink version and combustor cross section is one third of that of the flight combustion chamber. Three numbers of special purpose fuel injector-cum- flame holding struts (Inconel-718) are also realized and will be assembled to the test combustor prior to testing. Combustor (inside) dimensions are: overall length: 2000 mm, width: 400 mm and height: 100 mm (strut).

Scramjet test combustor modules, fuel injection strut components, transition adaptor and air heater nozzle module realized by MME were handed over on January 12, 2021 by Shri M Mohan, Deputy Director, VSSC(MME) to Shri Roy M Cherian, Associate Director, VSSC in presence of Shri MK Suresh, Project Director, ABPP and other senior officials.

Handing over of scramjet test combustor components

CONSTRUCTION FOR PCM PRODUCTION HUB INITIATED

Construction of production hub for chemicals and polymeric products for ISRO Projects (PCM Production Hub) was initiated with a function on January 18, 2021 in presence of Shri S Somanath, Director, VSSC and other senior officials. The production hub is being established in TERLS area, adjacent to the CMPD Building and Hypersonic Wind Tunnel facility. Having a total area of 2169.25 m^2, the production hub consists of a main building comprising of process rooms, product storage room, transit raw material store and in-process lab along with a dedicated solvent store, raw material store and utility room. The building is planned to be installed with 19 process equipments, 10 analytical equipments and 17 types of utilities. Major equipments are polymerization reactors of 10 liter – 100 liter capacities, helicone mixer, industrial rotavapor, high shear mixer, centralized nitrogen, vacuum and compressed air units, moisture and viscosity analyzers and auto titrator. The construction is expected to be completed by December 2021.

3D view of PCM production hub

Mechanisms Assembly Facility and Gallery inaugurated

Shri S Somanath, Director, VSSC inaugurated the Mechanisms Assembly Facility and Mechanisms Gallery on January 11, 2021 in presence of Shri A Shooja, Deputy Director, VSSC(MVIT). The assembly facility consists of 600 m^2 assembly bay with additional seating and storage area. It is located at Valiamala near Zero g test facility of ASMG. The facility is intended for assembly of new mechanisms being developed for ISRO's advanced programs like Gaganyaan, recoverable launch vehicles, etc.

Mechanisms Gallery is an initiative of ASMG towards knowledge sharing about the launch vehicle and satellite technologies developed by the mechanisms group till date. It also exhibits the photographs of good old memories of Valiamala complex and its evolution.

Enhanced mobile coverage in VSSC

BSNL is meeting diverse communication requirements of our Centre. It provides data channels for internet connectivity and launch support, and voice channels linking the 4000-line digital Electronic Private Automatic Branch Exchange (EPABX) to city exchanges. BSNL also caters to residential lines and Closed User Group (CUG) mobiles of the officials. The mobile coverage inside the campus was improved by erecting roof mounted mobile systems in Main Building, Project Complex, INSTEF area, Polyclinic and Akkulam Staff Quarters.

To further enhance the mobile coverage in low signal areas, pole based antennae systems were installed by BSNL at the rooftops of VRC Canteen and Administration building, ATF which covers the area of PCM at VRC and PRO, Guest Houses and Administration building at ATF.

The rooftop antennae system at VRC Canteen was inaugurated

by Shri CV Vinod, Indian Telecom Service (ITS), Chief General Manager, BSNL, Kerala Circle on January 08, 2021 in presence of Shri S Somanath, Director, VSSC, Dr Sharad Chandra Sharma, Associate Director, VSSC(R&D), Shri C Rajendran, ITS, Principal General Manager, BSNL Thiruvananthapuram Business Area, Shri NK Sukumaran, ITS, General Manager (Enterprise Business), BSNL Kerala Circle, Smt S Athula Devi, Deputy Director, VSSC (MSA) and Shri B Presennakumar, Group Director, NTSG/MSA.

Inauguration of rooftop antennae system

Liquid incinerator facility inaugurated

Shri S Somanath, Director, VSSC inaugurated the Liquid Incinerator Facility for Effluent (LIFE) of CSMG on January 21, 2021. The facility is installed near to the solid waste incinerator in RPP area and will cater to the need for the safe disposal of various flammable liquid wastes generated in the Centre.

The incinerator is diesel fired and designed to dispose a maximum of 100 litres/hr of flammable solvents. The primary chamber has an operating temperature of 850±50 °C and secondary chamber 1100±50 °C. Quench column and a wet scrubber are installed in the facility to ensure the emissions from the chimney are in accordance with the norms specified by Kerala State Pollution Control Board (KSPCB).

RH560 MkIII-F01/SOUREX mission booster rocket motor flagged off

SOUREX series of experimental launches are planned using RH560 MkIII sounding rockets to study upper atmosphere (90 km to 450 km) with TMA (Tri-methyl Alumina), Langmuir probe and ENWi probe as payloads.

RH560 MkIII is a two stage, fin stabilized, spinning and unguided sounding rocket, capable of carrying a payload of 100 kg to 500 km altitude. The first stage of rocket is powered by RH560M motor and second stage by RH300 MkII motor, known as booster and sustainer motors respectively.

The RH560 MkIII-F01/SOUREX mission launch is scheduled during March 2021 from SDSC SHAR.

Booster rocket motor being flagged off

Shri S Somanath, Director, VSSC flagged off the booster rocket motor from VSSC to SDSC SHAR on January 7, 2021 in presence of Dr Radhika Ramachandran, Director, SPL and Shri J Jayaprakash, Deputy Director, VSSC (SPRE).

Revised Indian Atmospheric Model, 2020

Realistic atmospheric models based on actual measurements are of utmost importance for both scientific research and technical applications. Study and characterization of various atmospheric processes involve the use of atmospheric models. ISRO's operational and developmental projects which require aerodynamic load characterization, re-entry of spent stage, recovery of reusable stages, structural, thermal, control and guidance design, Space debris estimation and many others, also make use of the atmospheric models. In India, a standard atmosphere with emphasis on the tropics was developed as early as 1959. However, there have been regular updation of this model from time to time with the availability of better and new atmospheric measurements. The latest reference atmosphere that has been in use in our technical and developmental programs is ISRO-Standard SCAN-85 that is based on the SPL/VSSC's indigenous model, also referred to as Sasi and Sengupta model, 1979. Recently, an effort was made to upgrade this model. In fact, the model was regenerated to accommodate the spatio temporal variability with dispersions of desired atmospheric parameters like temperature and density. A team consisting of experts and scientists/engineers from all the concerned research areas in SPL and other entities of VSSC was formed with this task of upgradation. Dr V Adimurthy,

Hon. Distinguished Professor, VSSC spearheaded the team while Dr KN Uma, SPL coordinated the overall activities as Member-Secretary. The team recently completed first phase of this activity and brought out a report describing the revised model based on extensive studies and new datasets. A copy of this report was presented to Shri S Somanath, Director, VSSC by Dr Radhika Ramachandran, Director, SPL on January 25, 2021.

Webinar on ongoing TDP/ Adv. R&D activities in VSSC

Webinar on ongoing TDP/ Adv. R&D activities was organized for the first time in VSSC during December, 2020 – January 2021. Shri S Somanath, Director, VSSC inaugurated the webinar and addressed the participants. Webinar was held in two sessions on December 18, 2020 and January 7, 2021. Thirty-two TDP/Adv. R&D activities spread across various entities/projects, shortlisted after multiple levels of screening, were presented in the webinar.

An evaluation committee reviewed the presentations in the webinar and identified Star Performing Research Activities. Following three TDPs were selected as the Star Performing Research Activities in VSSC for the year 2020.

- Polycyclic silicone based high temperature resistant adhesive and composite for Space applications - PCM
- THERMal Analysis Package for Launch Vehicle Avionics (THERMAP) - AERO
- DroneNet - CGSE

The investigators of the Star Performing Research Activities were felicitated by Director, VSSC in the SSC meeting held in January 2021.

Fellow of Indian Academy of Sciences (FASc)

Dr S Suresh Babu, SPL is elected as a Fellow of Indian Academy of Sciences (FASc). Indian Academy of Sciences, founded in 1934 by Sir CV Raman, annually elects distinguished scientists of the country to its Fellowship acknowledging their contributions to science or engineering.

Dr S Suresh Babu

PhD awarded

Shri Roy Thankachan, QDAS/SR has been awarded the degree of Doctor of Philosophy by National Institute of Technology (NIT), Calicut for his thesis titled 'Despeckling techniques for polarimetric SAR images using Bandelet transform'. The research was carried out under the joint guidance of Dr PM Ameer, NIT, Calicut and Dr R Sethunadh, SR.

Dr Roy Thankachan

Merit Award Function - 2020

Director, VSSC inaugurating the award function

Merit Award Function 2020 jointly organized by VSSC Staff Benevolent Fund (SBF) & Space Centre Employees' Co-operative Society (SCECS) was held on January 28, 2021 at Dr Srinivasan Auditorium, VSSC.

Shri S Somanath, Director, VSSC presided over the function. Dr D Sam Dayala Dev, Director, IISU and Dr Biju Jacob, Chief Controller, VSSC offered felicitations. Shri R Harikrishnan, President, SBF welcomed the gathering and Shri B Anilkumar, Sr. Head, PGA proposed the vote of thanks.

A total of 92 awards were given during the function. A special felicitation of Shri VJ James, CMSE, Vayalar award winner 2019 and Shri R Rahul, ASOE winner of Ironman Triathlon competition held at Kalmar, Sweden was also done during the function.

Merit Awards

The awards are instituted for the wards of VSSC/IISU/LPSC employees, who are members in SBF/ SCECS.

*Award for the children of SBF/ SCECS members who secured the highest gradings/marks in **Standard X (SSLC)***

SR Nandana
d/o Shri B Suresh Kumar
(ASPD/AVN)

Anjana Mathew
d/o Shri Mathew Joseph
(APFD/AVN)

S Devika
d/o Shri NS Suresh Babu
(QIT/MME)

A Chandana
d/o Shri K Ashok Kumar
(BMPD/MSA)

AP Meenu
d/o Smt TR Prajeesha
(MME-PUR)

A Piowin Angel
d/o Shri M Alwin Jose
(SCOD/MVIT)

NM Manchima Nath
d/o Shri NK Manu Ranjnath
(TOMD)

PJ Stan
s/o Shri PY Jacob
(INSTEF/STR)

Megha Sajikumar
d/o Smt RG Rekha
(SPRE-PUR)

*Award for the children of SBF/ SCECS members who secured the highest gradings/marks in **Standard X (CBSE)***

P Meghna
d/o Smt Surya S Ram
(ADMN, MCF, HASSAN)

Thomas Biju Cheeramvelil
s/o Shri Biju C Thomas
(GSLV MkIII)

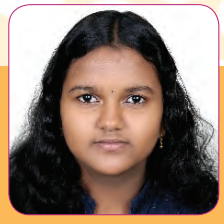
Saraswathy Ashok
d/o Smt H Swethalakshmi
(CGFSD/CGSE)

BNS Vasanthi
d/o Shri BSV Rama Sarma
(VAD/STR)

R Gopika Raj
d/o Smt C Rajani
(QID/AVN)

Science par Excellence Award 2020

KM Darshini
d/o Shri S Mariappan
(LVAF/MME)



P Sanika
d/o Shri Ullas Puthiyottil
(PER/GAD/LPSC)

S Aswin
s/o Smt KP Shajilmani
(CSPG/CSC/LPSC)

Saraswathy Ashok
d/o Smt H Swethalakshmi
(CGFSD/CGSE)

*Award for the children of SBF/ SCECS members who secured the highest gradings/marks in **Standard X (ICSE)***

Nikitha Binny
d/o Shri Binny Mathew
(SEIG/MVIT)

AV Ananthakrishnan
s/o Smt SJ Anjana
(FSD/AVN)

Parvathi Nair
d/o Dr UP Rajeev and
Smt Asha P Nair
(CGDG/CGSE)

Aarushi Jalan
d/o Dr Salil Kanj Jalan
(SDSD/STR)

Allan J Binoy
s/o Shri Binoy Jose
(FPD/MVIT)

MKS Rashmika
d/o Shri MK Sundaresan
(VAD/STR)

Roshan Parveen
d/o Shri KS Mansoor
(TMSD/CGSE)

G Jebisha Daphne
d/o Shri J Gladwin
(GSLV)

George Kurian Thomas
s/o Shri Thomas Kurian
(SMDG/SPRE)

R Akshay
s/o Smt P Bhagavathy
(TT&IC/MSA)

Janhavi Tiwari
d/o Dr Shashibhushan Tiwari
(AASD/STR)

Nitya Tiwari
d/o Dr Shashibhushan Tiwari
(AASD/STR)

Navya Ann Lal
d/o Shri MJ Lal and
Smt Sheena Abraham
(PSLV)

Vishaal Anilkumar
s/o Smt Saritha Anil Kumar
(PACC)

*Award for the children of SBF/ SCECS members who secured the highest gradings/marks in **Standard XII (State)***

Krishna R Jain
d/o Shri T Ramesh Jain
(ESMD/MSA)

MG Anamika
d/o Shri K Gopakumar
(CMD-ELE)

AP Devu
d/o Smt TR Prajeesha
(MME-PUR)

Akhil K Arun
s/o Shri KC Arun
(BSED/AVN)

*Award for the children of SBF/ SCECS members who secured the highest gradings/marks in **Standard XII (CBSE)***

Anjana P Sekhar
d/o Shri S Prakash Sekhar
(CMD-PBC)

S Madhuri Sivan
d/o Shri RS Sivakumar
(SCOD/MVIT)

Devika Renjith
d/o Shri Renjith Keezhoth
(NITD/CGSE)

KS Adithyan
s/o Smt NP Rehna
(HTSTF/MME)

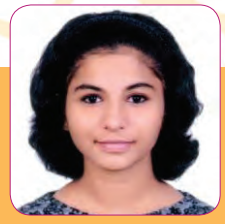
RS Gouripriya
d/o Shri R Rajkumar
(LSMG/MVIT)

S Anagha
d/o Shri V Sreekanth
(PGA)

Riya Sebastian
d/o Smt NJ Mariamma
(EST/PGA)

R Kavya
d/o Shri CG Rajendran
(MED)

V Aswin Jino
s/o Shri S Vijin Jenius
(RQA-SISG/IISU)



Shreya Susan Mathew
d/o Shri Mathew P Daniel
(S200 PROJECT)

Award for the children of SBF/ SCECS members who secured the highest gradings/ marks in ***Standard XII (Indian School Certificate Examination)***

Sarath Roy
s/o Smt LB Chitra Devi
(MED)

Sarangi Shyam
d/o Shri N Shyam Mohan
(STG/STR)

Advaith Balamurali
s/o Shri AG Balamurali
(SMD/STR)

S Aravind Ramnath Pai
s/o Shri K Suresh
(GSLV MkIII)

Akhil S Kumar
s/o Shri GD Sunil Kumar
(TOMD)

Ann Sonny
d/o Smt KC Finitha
(ASPD/AVN)

Graduates & Post Graduate ***rank holders***

Ann Mary Roy
d/o Shri Roy Samuel
(TOMD)

V Pavithra
d/o Smt V Beena
(CGSE)

Dr Adimurthy Endowment Award for Blood Donation 2020

Give the gift of life

N Binu
(PED/PCM)

V Binu
(PPFF/MME)

Ajai Joseph
(APEP/SPRE)

AK Arun
(CACC)

Juluri Sreenivasulu
(ACD/AERO)

B Krishnakeerthi
(MED)

CV Rajesh
(MDPG/ISP/IISU)

V Sanoj
(GSLV MkIII)

S Somanathan
(QDSM/SR)

H Ajith Kumar
(PED/PCM)

CS Kiran
(MDPG/ISP/IISU)

V Rajesh
(APPD/CMSE)

B Rejikumar
(APPD/CMSE)

S Sreekumar
(MDPG/ISP/IISU)

Raj P Thankappan
(CGHS)

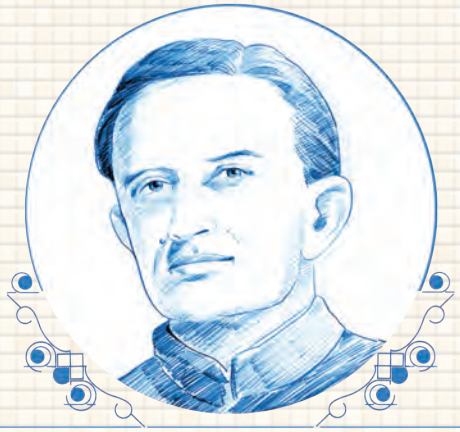
KT Abdul Raoof
(MDPG/ISP/IISU)

K Noorul Ameen
(HWTD/AERO)

Dhanunjaya Pyla
(MDPG/ISP/IISU)

KG Ramesh Kumar
(APD/PCM)

B Ammani
(LPSC)



Dr Vikram Sarabhai MEMORIAL AWARD

FOR HAVING COMPLETED HIGHER STUDIES

Manu M
(COM/MSA)

N Murukesh
(SASD/SIS/IISU)

Geetha S Nair
(R&R/PGA)

Dr S SRINIVASAN
Memorial Award for Best Composite Technician

VC Dilraj
(CMAD/CMSE)

Dr KOSHY M GEORGE
Endowment Award for outstanding contributions in manufacturing/materials

C Krishnadas
(QIT/MME)

Dr VASANT R GOWARIKER
Memorial Best Idea Award

N Vasudevan
(APPD/CMSE)

GSLV
Lifetime Achievement Award

PV Sunil Kumar
(TDAD/MSA)

GSLV
Young Achiever Award

Suhas Mukherjee
(PED/PCM)

LVM3
Award for specific and significant contributions

N Balasubramanian
(RMPF/SPRE)

SARABHAI
Quality Award

Atal Krushan Khatua
(QDPC/SR)

LVM3-X MISSION
Commemoration Award

Alok Kumar Patel
(RMPF/SPRE)

SP Shan
(RMPF/SPRE)

PSLV AWARD
for outstanding contributions

V Vibha
(PSD)

SARADHI
of the Year

Keny Periera
(TOMD)

PRASHASANIK SHRESHTATHA PURASKAR
SBF Award for Admin & Aux. Staff

S Ambika Devi
(VGS/PGA)

VK Ambika
(CMSE)

SBF AWARD FOR
best driver

SK Ajikumar
(TOMD)

AKSHAYA PURASKAR
SBF Award for canteen staff

K Venugopalan
(CGHS)

SHRI G RAVINDRANATH
Endowment Award for specific and significant contributions

MK Chackochen
(HSPD/ASOE)

R Raman
(TTVTD/AIS/IISU)

Special felicitation to winners of external awards

IRON MAN
AWARD FOR SPORTS

R Rahul
(STED/ASOE)

Vayalar Award 2019
FOR LITERATURE

VJ James
(CCTD/CMSE)

Voluntary Retirement

Smt KT Charateena left the Centre on January 5, 2021. While appreciating her valuable services, Countdown wishes all success in her future endeavours.

KT Charateena
AVN
Joined on 01.07.1983

Obituary

S Jeyakumar
TOMD

Joined on 22.11.2019

Survived by wife and two sons

Countdown records with profound grief
the sad demise of Shri S Jeyakumar

Our heartfelt condolences to the bereaved family

Combined coastal security exercise

With the changing security scenario around the world, there are increasing threats to vital installation/assets of the country. Assets of Space technology are crucial for the development of our country and thus remain a prime target for antinational elements/ perpetrators inimical to the progress of our country. In order to counter such nefarious plans, the security agencies draw out contingency plans and make it operational by practicing, after creating real time situations. The outcomes of such exercises are evaluated to plug the loopholes and strengthen the security infrastructure.

Combined coastal security exercise is one of such effort intended to identify the loopholes in security infrastructure/plans, in protection of coastal belt of the Kerala state. This is undertaken with participations from Indian Coast Guard, Indian Navy, State Administration, State Police including Coastal Police, Intelligence Bureau, Fisheries Department, Marine Enforcement Wing, Vigilance Wing, Director of Ports, Cochin Port Trust, CISF and other vital installations situated across the coastal area. Such exercises are conducted on half yearly basis named as Sea Vigil/ Sagar Kavach. The main objective is to equip the state police, especially the coastal police and other security agencies fully prepare to face and prevent any impending threat from antinational elements and terrorists who try to attack vital installation/ assets in the state after sneaking in to land through sea route using fishing boats or any other vessel from sea in disguise of fisherman.

The last exercise named 'Sea Vigil-01/2021' was conducted on January 12th and 13th, 2021 all along the coastline of Kerala. As part of the exercise, one attacking group named 'Red Force Team' was deployed along the Kerala coast line, whose mission is to infiltrate/attack the vital installation/ assets in the state. Different security agencies including CISF try to prevent such infiltration and attacks by coordinated effort and the exercise is monitored round the clock for identifying the threat perception and loopholes.

Republic Day Celebrations 2021

The 72nd Republic Day was celebrated in VSSC with Flag hoisting ceremony in front of the main building, VRC. Due to the restrictions imposed by pandemic COVID-19, the function was arranged in a very modest way, strictly as per the guidelines issued by State and Central Governments. The Republic Day was celebrated with minimum number of participants and duration of the programme was restricted to 15 minutes. Live streaming of the programme was arranged through 'YouTube' from 07:30 hrs onwards to reach out to the employees at large. Shri S Somanath, Director, VSSC ceremoniously welcomed and escorted by Commandant, CISF. Director, VSSC hoisted the National Flag at 08:00 hrs in presence of Dr Biju Jacob, Chief Controller, VSSC, VCMC members and other senior officials and received the salute from the CISF contingent. This was followed by collective singing of National Anthem. After the flag hoisting, Director, VSSC addressed the gathering and extended Republic Day greetings and New Year wishes to all those who had gathered to grace the occasion and those watching the programme live. He emphasized the importance of Republic Day celebration and the need for realizing the missions of ISRO/DOS lined up during 2021 amid the prevailing pandemic situation. He urged upon all employees to see this as an opportunity and strive hard for achieving excellence in the field of Space Science and Technology. The parade was dispersed at 08:15 hrs. This was followed by the beautiful rendition of a Patriotic song by the students of VSSC Central School led by their music teacher.

डॉ. श्रीनिवासन स्मारक व्याख्यान

17 जनवरी, 2021 को एयरोनॉटिकल सोसाइटी ऑफ इंडिया (एईएसआइ), तिरुवनंतपुरम शाखा द्वारा विक्रम साराभाई अंतरिक्ष केंद्र (वीएसएससी) के साथ मिलकर डॉ. श्रीनिवासन स्मारक व्याख्यान आयोजित किया गया था। कोविड-19 महामारी से संबंधित प्रतिबंधों के कारण इस समारोह का आयोजन वीएसएससी यूट्यूब चैनल के माध्यम से ऑन-लाइन विधा में किया गया था। डॉ. जी सतीश रेड्डी, सचिव, रक्षा अनुसंधान एवं विकास विभाग तथा अध्यक्ष, डीआरडीओ ने "भारतीय वैमानिकी और इको-सिस्टम" विषय पर व्याख्यान दिया।

भारत में वैमानिकी के इतिहास से शुरू करते हुए, उन्होंने लड़ाकू विमानों, स्थाई पंख वायुयानों के प्रादुर्भाव और भारत में वायुयान इंजन के उत्पादन के बारे में एक विस्तृत परिदृश्य सामने रखा। इस रोचक एवं ज्ञानदायक व्याख्यान में डॉ. रेड्डी ने यह संदेश दिया कि भारत में वैमानिकी अभिकल्पना, विकास तथा निर्माण की क्षमताओं में अत्यंत वेग से प्रगति हुई है जिससे हमारे देश को एक प्रमुख अंतर्राष्ट्रीय खिलाड़ी का दर्जा दिलाया जा सका है। आयात पर की जानेवाली आश्रितता को कम करने और उद्योग की निर्यात संभाव्यता को बढ़ाने के लिए सरकार द्वारा प्रारंभ किए गए उपायों पर उन्होंने बात की।

डॉ. डी साम दयाला देव, अध्यक्ष, एईएसआइ, तिरुवनंतपुरम शाखा/ निदेशक, आइआइएसयू ने इस समारोह की अध्यक्षता की। श्री एस सोमनाथ, निदेशक, वीएसएससी और डॉ. वी नारायणन, निदेशक, एलपीएससी ने आशीर्वचन दिए। श्रीमती ए पी बीना, उपाध्यक्षा, एईएसआइ, तिरुवनंतपुरम शाखा ने सभा का स्वागत किया तथा डॉ. एल मोहन कुमार, माननीय सचिव, एईएसआइ, तिरुवनंतपुरम शाखा ने धन्यवाद ज्ञापन किया।

Best paper award

Dr Kandula V Subrahmanyam, SPL won the 'Best Paper Award' for his paper titled 'Characterizing the diurnal variation of precipitating clouds as observed by C-band Polarimetric Doppler Weather Radar at Thumba' in the 'National E-Symposium on Cloud and Precipitation Processes' conducted by Indian Meteorological Society (IMS) and Indian Institute of Tropical Meteorology (IITM) Pune on January 19th and 20th, 2021. The paper was co-authored by Dr K Kishore Kumar, SPL.

Dr Kandula V Subrahmanyam

Intellectual assets

The following patent application was filed from the Centre

Reactive adhesive coated slurry casting process as repair technique for solid propellant motors

Inventors : Shri PS Sathis kumar, Shri RV Lakshmi Kanth, Shri Vinay Paliwal, Shri U Ramlet, Shri P Sojan, Shri VS Syam (SPRE), Shri CR Thomas (MSA-Retired).

The invention provides a reactive adhesive coating composition for processing defective solid propellant grains. The invention also provides a process for remedying the defects in cured solid propellant grains by employing fresh slurry propellant after reactive adhesive coating. The invention is useful for solid propellant grain processing to salvage defective grain by removing the defective portion and recast with slurry propellant without compromising the performance. It is also useful in repairing aged propellant motor which needs to be disposed safely.

PS Sathis kumar

RV Lakshmi Kanth

Vinay Paliwal

U Ramlet

P Sojan

VS Syam

CR Thomas

Superannuation

Following colleagues bade goodbye on superannuation on January 31, 2021

Radhika Ramachandran
SPL
Joined on 17.01.1984

M Vijayakrishnan
QDTT
Joined on 17.03.1986

R Paramasivam
FCG
Joined on 08.08.1986

N Jayaraman
CSMD
Joined on 17.09.1990

While appreciating their valuable service rendered to the Centre,
Countdown wishes them happy, purposeful and prosperous retired life.

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Suggestions / feedback
countdown@vssc.gov.in

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